



PBCS Monitoring in FAA Oceanic Airspace

CPWG22

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FAA

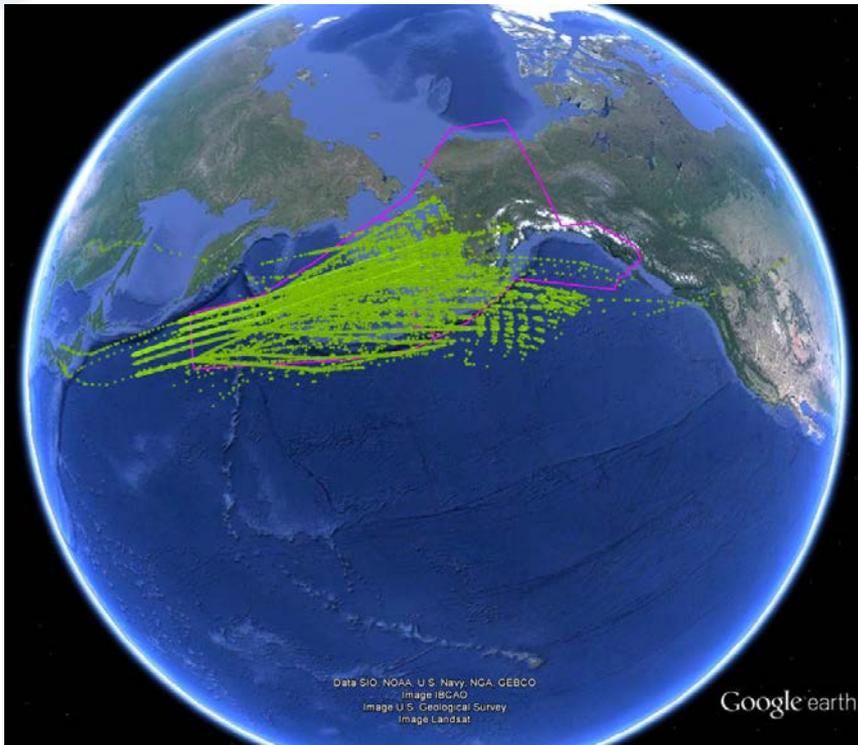


Federal Aviation
Administration

Overview

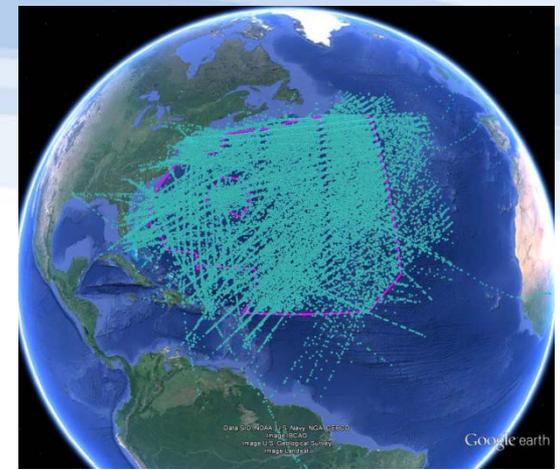
- Overview of FANS Data Link Usage in US Oceanic FIRs
- Summary of Reported Outages and Measured Availability
- PBCS Performance Criteria
- How to Read PBCS Monitoring Charts
- Aggregate FANS Data Link Performance
- ASP for SATCOM Station Identifiers by FIR
- Aggregate FANS Data Link Performance by Operator
- Aggregate FANS Data Link Performance for Business Jet Aircraft Types
- FANS over Iridium usage and ASP by Operator/Aircraft Type

Anchorage FIR (PAZA) FANS Data Link Usage



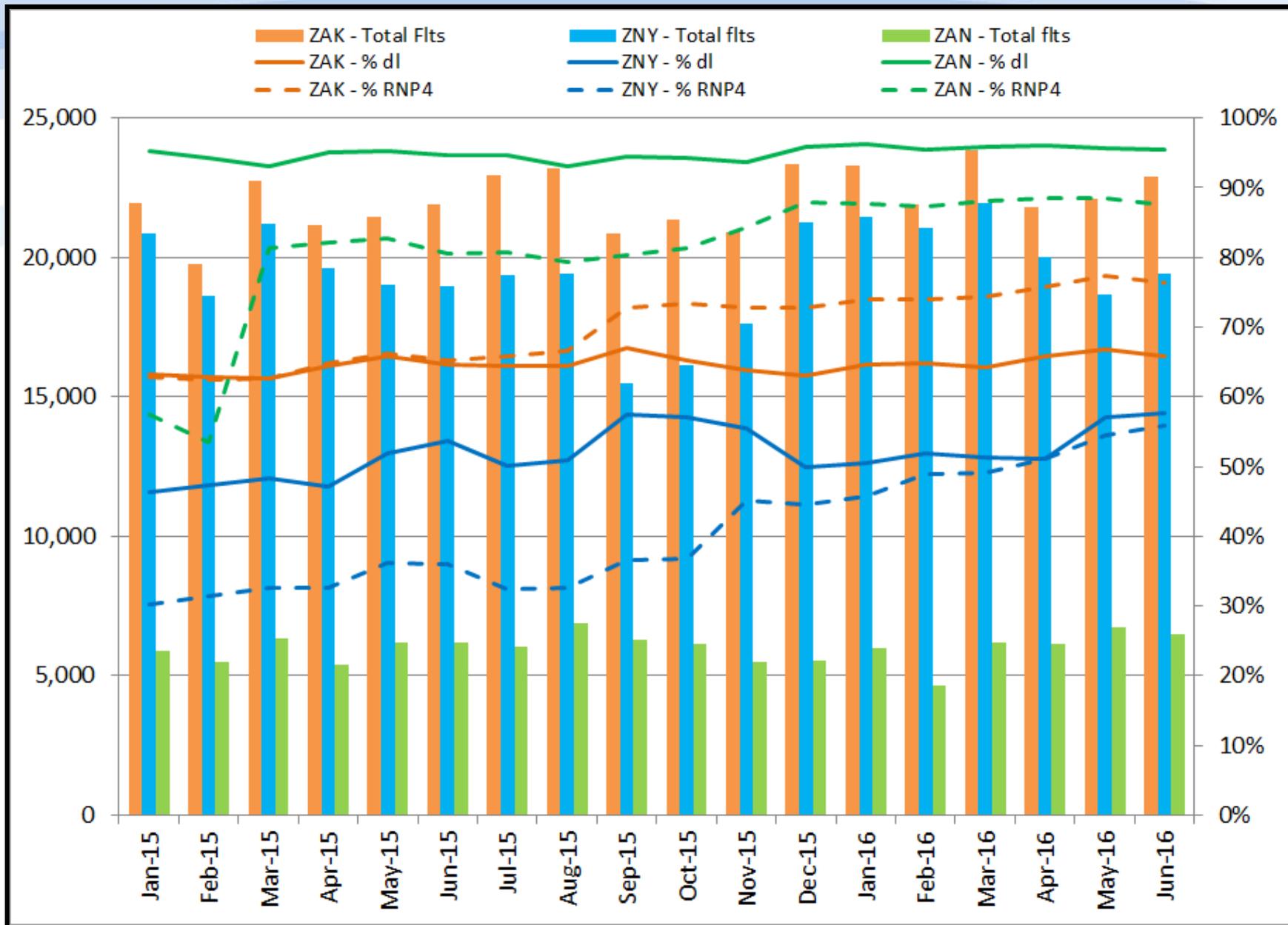
	Jul-Dec 2015	Jan-Jun 2016
Total flights	36,371	36,227
% flights using FANS data link	94%	96%
% RNP4	82%	88%
Individual airframes using FANS data link	1,650	1,696

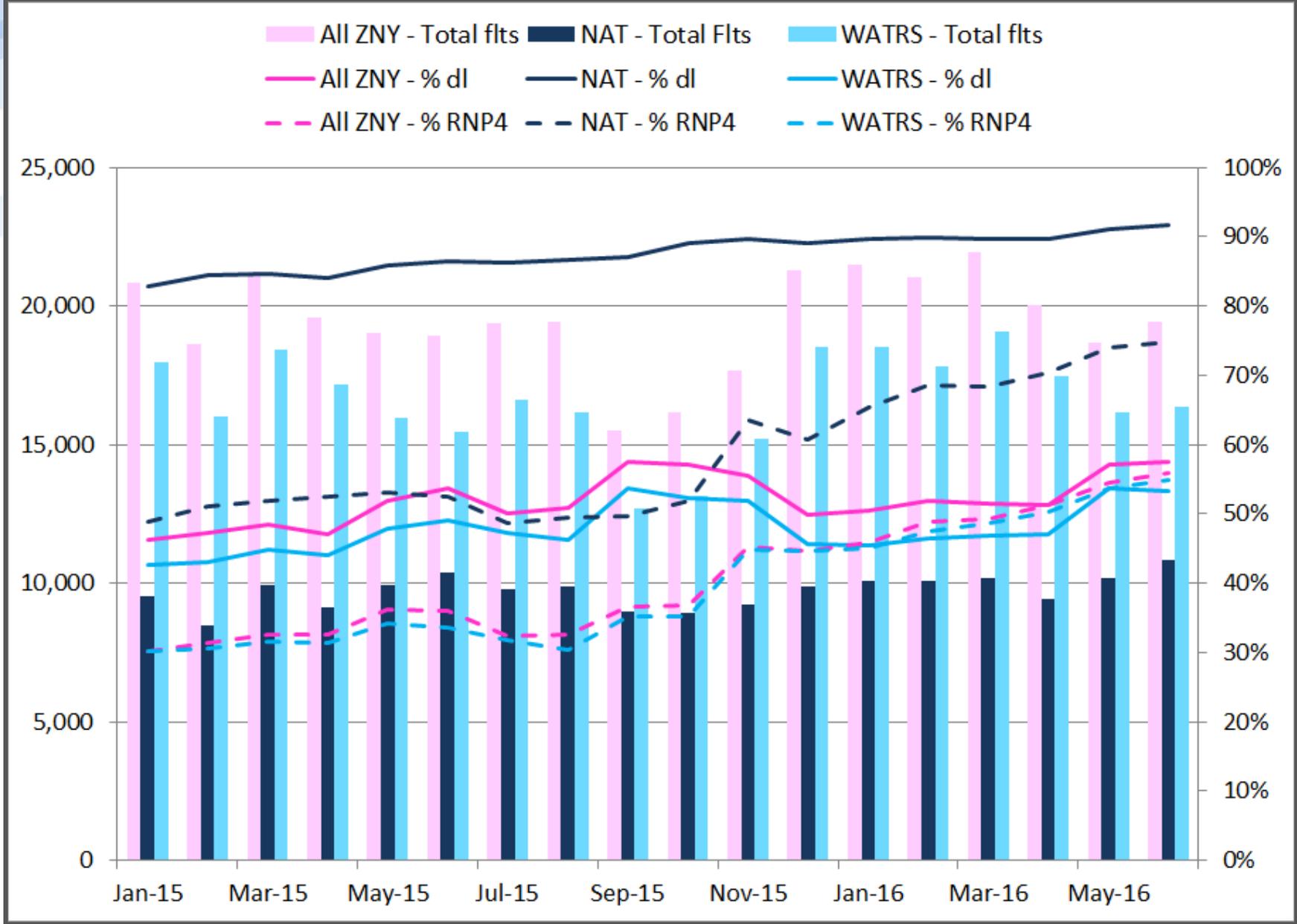
New York FIR (KZNY) FANS Data Link Usage



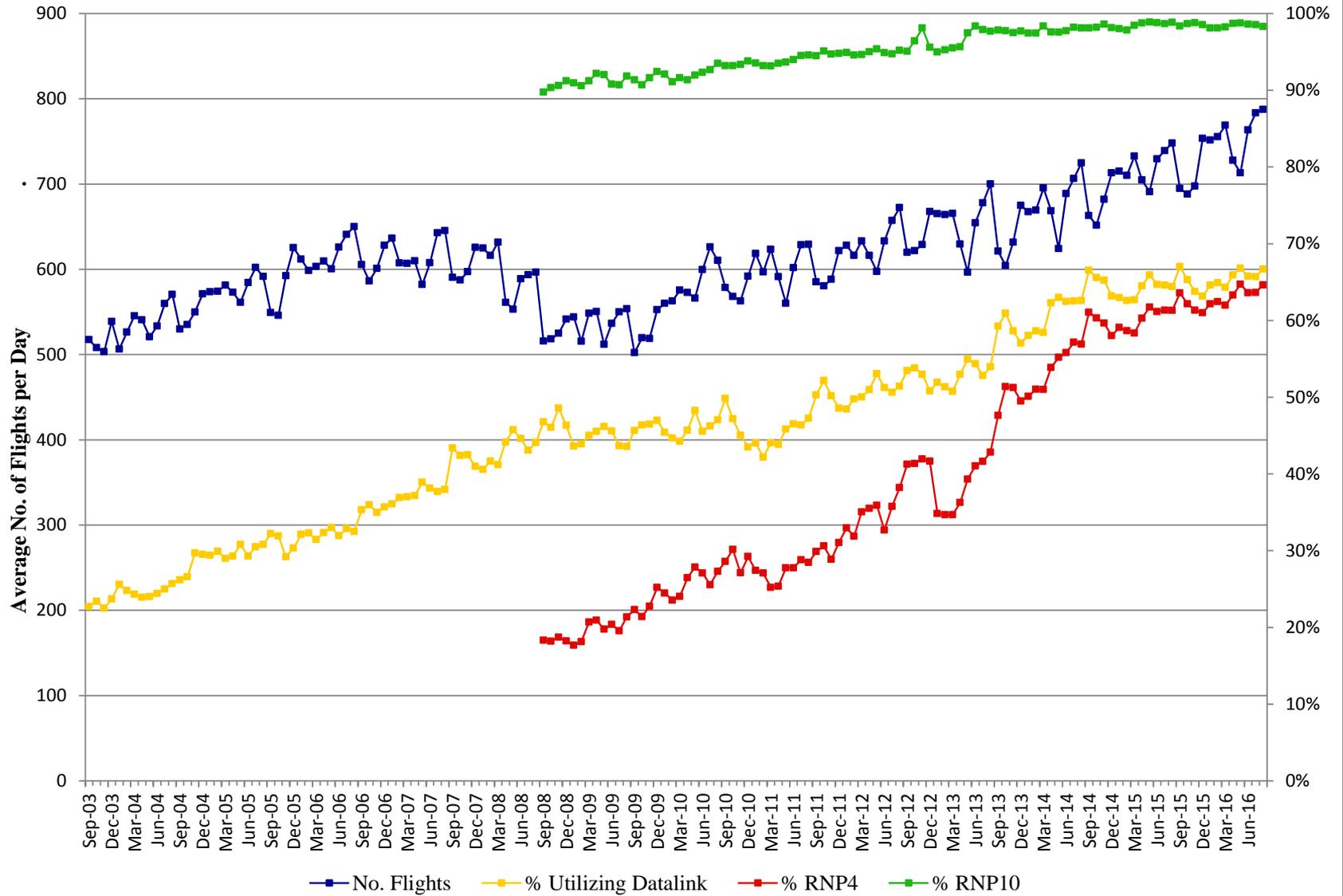
	KZNY		KZNY-E (NAT)		KZNY-W (WATRS)	
	Jul-Dec 2015	Jan-Jun 2016	Jul-Dec 2015	Jan-Jun 2016	Jul-Dec 2015	Jan-Jun 2016
Total flights (6 months)	109,374	122,585	56,624	60,799	92,387	105,452
% flights using FANS data link	53%	58%	88%	92%	49%	54%
% RNP4	38%	56%	54%	75%	37%	55%
Individual airframes using FANS data link	2,966	3,335				

Note: Some flights are included in both ZNY-E and ZNY-W





ZOA Flights & Equipment Utilization



Unexpected Outages Reported between – 21 January 2016 and 16 July 2016

START DATE	START TIME (UTC)	DURATION (HH:MM:SS)	SERVICE IMPACTED	SATELLITE REGION IMPACTED	NOTIFICATION SOURCE	NOTES
21-Jan-16	21:37	00:55:00	Inmarsat I-4	EMEA	ARINC	Inmarsat network service degradation in I-4 EMEA for SwiftBroadband
29-Jan-16	00:00	01:20:00	Inmarsat SBB	PAC SBB	ARINC	Paumalu resolved an internal issue to restore service.
5-Feb-16	12:27	00:48:00	Inmarsat I-4	EMEA	SITA	Voice and Data Services over Fucino EUA1 region is degraded
11-Feb-16	04:48	01:24:00	Inmarsat SBB	PAC SBB	ARINC	Bad Uplink format to XXU. Inmarsat NOC manually logged of AES
19-Feb-16	20:27	01:13:00	Inmarsat I-4	EMEA	ARINC	Inmarsat network service degradation
20-Feb-16	09:36	00:47:00	Inmarsat I-4	EMEA	ARINC	Inmarsat network service degradation
7-Mar-16	11:30	00:24:00	Inmarsat I-4	ASIA-PAC	ARINC	Inmarsat network service degradation
17-Mar-16	22:12	00:34:00	Inmarsat I-4	EMEA	ARINC	Inmarsat network service degradation
30-Mar-16	18:00	02:57:00	Inmarsat I-4	EMEA	SITA	Unexpected System Maintenance - SATELLITE AIRCOM - Inmarsat Voice and Data Services
30-Mar-16	18:28	02:32:00	Inmarsat I-4	EMEA	ARINC	INMARSAT unscheduled loss of Network service
1-Apr-16	21:11	00:54:00	Inmarsat SBB	Paumalu	ARINC	Inmarsat resolved an interference issue
13-Apr-16	02:13	03:09:00	Iridium	Global	ARINC	Telephony provisioning requests made between 00:41 GMT to 05:04 GMT went to error status due to a hardware issue on the network element. All of these errors have now been resolved with the requests being resent successfully and the services correct on the network elements. This affected telephony provisioning only, no other services were affected.
12-May-16	07:33	01:18:00	SITA	Global	ARINC,SITA	Service outage for SITA Aircom services
12-May-16	01:45	00:13:00	ARINC	ASIA-PAC	ARINC	ARINC Inmarsat Swift broadband service outage
10-Jul-16	04:39	06:24:00	New York FIR	New York FIR	ARINC	FAA ARTCC advised their service provider FTI had to reload a router in NY to restore service
16-Jul-16	06:17	01:06:00	New York FIR	New York FIR	ARINC	FAA ARTCC advised their service provider FTI had to resolve further issue with a router in NY to restore service

Measured Availability

Using Reported Outages from Jul 2015 to Jun 2016

Satellite	Region	DSP	Path ID	# unplanned outages affecting path > 10 min	Sum of unplanned outages affecting path > 10 min (min)	Estimated availability for path
Inmarsat I-3	AOR-E	SITA	AOE2	2	92	99.98%
		ARINC	XXN	0	-	100.00%
	AOR-W	SITA	AOW2	2	92	99.98%
		ARINC	XXW	0	-	100.00%
	IOR	SITA	IOR2	3	112	99.98%
		ARINC	XXI	3	278	99.95%
	POR	SITA	POR1	4	400	99.92%
		ARINC	XXP	2	372	99.93%
Inmarsat I-4	EMEA	SITA	EUA1	7	427	99.92%
		ARINC	XXF	7	403	99.92%
	Americas	SITA	AME1	2	92	99.98%
		ARINC	XXH	0	-	100.00%
	Asia-Pac	SITA	APK1	2	92	99.98%
		ARINC	XXA	1	24	100.00%
Iridium	Global	SITA	IGW1	6	714	99.86%
		ARINC	IG1	3	539	99.90%
PBCS criteria - max values						
Safety - 99.9%				48	520	99.90%
Reliability - 99.99%				4	52	99.99%

	Meets safety and reliability criteria
	Meets safety criteria only
	Does not meet safety or reliability criteria



PBCS Performance Criteria

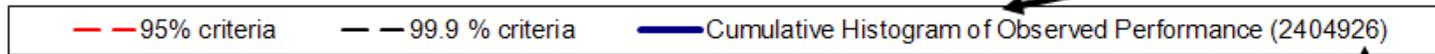
Time/Continuity

Performance Measure	Percentage of Messages Required to Meet Criteria	ADS-C		CPDLC	
		RSP180 Criteria (sec)	RSP400 Criteria (sec)	RCP240 Criteria (sec)	RCP400 Criteria (sec)
ASP Actual Surveillance Performance	95%	90	300		
	99.9%	180	400		
ACTP Actual Communication Technical Performance	95%			120	260
	99.9%			150	310
ACP Actual Communication Performance	95%			180	320
	99.9%			210	370
PORT Pilot Operational Response Time	95%			60	60

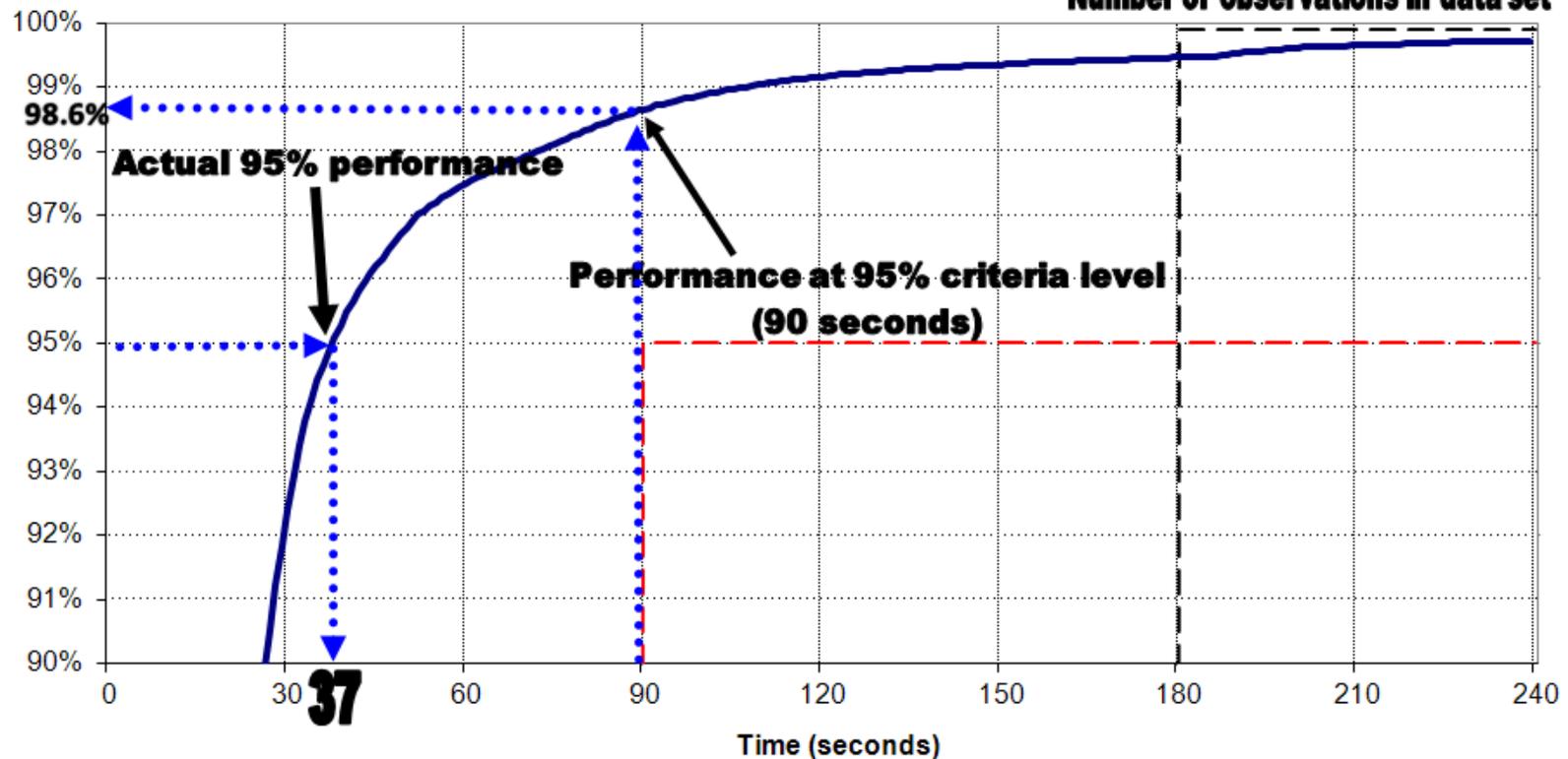
How to Read PBCS Monitoring Charts

ADS-C Downlink Latency

Description of data set



Number of observations in data set



January to June 2016

DATA LINK PERFORMANCE BY MEDIA TYPE



Performance by Media Type

87,287 flights

January – June 2016

Oakland

Media Type	ADS-C			CPDLC					
	Count of ADS-C Downlink Messages	ADS-C 95%	ADS-C 99.9%	Count of CPDLC Transactions	ACTP 95%	ACTP 99.9%	ACP 95%	ACP 99.9%	PORT 95%
Performance Criteria		RSP 180			RCP 240				
Aggregate	2,626,049	98.6%	99.4%	107,170	99.7%	99.7%	99.5%	99.7%	98.5%
SAT	2,341,346	98.7%	99.5%	105,150	99.7%	99.7%	99.5%	99.7%	98.6%
VHF	273,452	99.0%	99.5%	1,422	99.7%	99.7%	99.4%	99.5%	97.8%
HF	11,241	68.3%	81.9%	11	--	--	--	--	--
HF-SAT				152	99.3%	99.3%	97.4%	98.0%	82.9%
SAT-VHF				148	98.7%	100.0%	98.0%	100.0%	93.9%
SAT-HF				143	88.1%	90.2%	90.9%	92.3%	96.5%
VHF - SAT				141	85.1%	88.7%	88.7%	90.1%	97.9%
VHF-HF				2	--	--	--	--	--
HF-VHF				1	--	--	--	--	--



Performance by Media Type

34,908 flights

January - June 2016

Anchorage

Media Type	ADS-C			CPDLC					
	Count of ADS-C Downlink Messages	ADS-C 95%	ADS-C 99.9%	Count of CPDLC Transactions	ACTP 95%	ACTP 99.9%	ACP 95%	ACP 99.9%	PORT 95%
Performance Criteria		RSP 180			RCP 240				
Aggregate	1,120,851	98.2%	99.3%	24,666	99.5%	99.6%	99.3%	99.5%	98.1%
SAT	778,941	97.9%	99.3%	16,886	99.5%	99.6%	99.3%	99.5%	97.9%
VHF	335,568	99.4%	99.6%	7,117	99.9%	99.9%	99.7%	99.8%	98.8%
HF	6,295	66.3%	81.1%	10	--	--	--	--	--
SAT-VHF				374	98.4%	98.9%	98.1%	98.4%	96.8%
VHF-SAT				185	95.7%	97.3%	95.1%	97.3%	95.1%
SAT-HF				48	--	--	--	--	--
HF-SAT				37	--	--	--	--	--
VHF-HF				8	--	--	--	--	--
HF-VHF				1	--	--	--	--	--



Performance by Media Type

64,621 flights

January - June 2016

New York

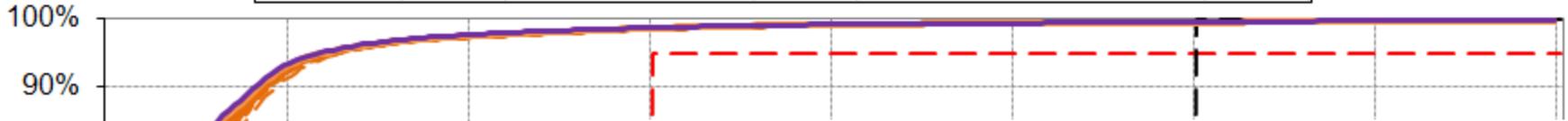
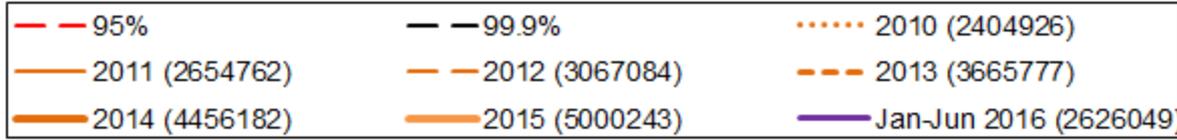
Media Type	ADS-C			CPDLC					
	Count of ADS-C Downlink Messages	ASP 95%	ASP 99.9%	Count of CPDLC Transactions	ACTP 95%	ACTP 99.9%	ACP 95%	ACP 99.9%	PORT 95%
Performance Criteria		RSP 180			RCP 240				
<i>Aggregate</i>	1,830,619	98.4%	99.4%	56,579	99.5%	99.6%	99.1%	99.4%	96.9%
SAT	1,406,278	98.3%	99.4%	51,952	99.6%	99.7%	99.2%	99.4%	96.9%
VHF	421,306	99.2%	99.6%	3,834	99.9%	99.9%	99.6%	99.8%	97.2%
HF	3,018	57.2%	73.3%	1	--	--	--	--	--
SAT-VHF				410	98.5%	98.8%	97.1%	97.8%	94.6%
VHF-SAT				310	92.3%	94.8%	91.0%	93.2%	88.1%
SAT-HF				53	--	--	--	--	--
HF-SAT				17	--	--	--	--	--
VHF-HF				2	--	--	--	--	--

2010 - 2016

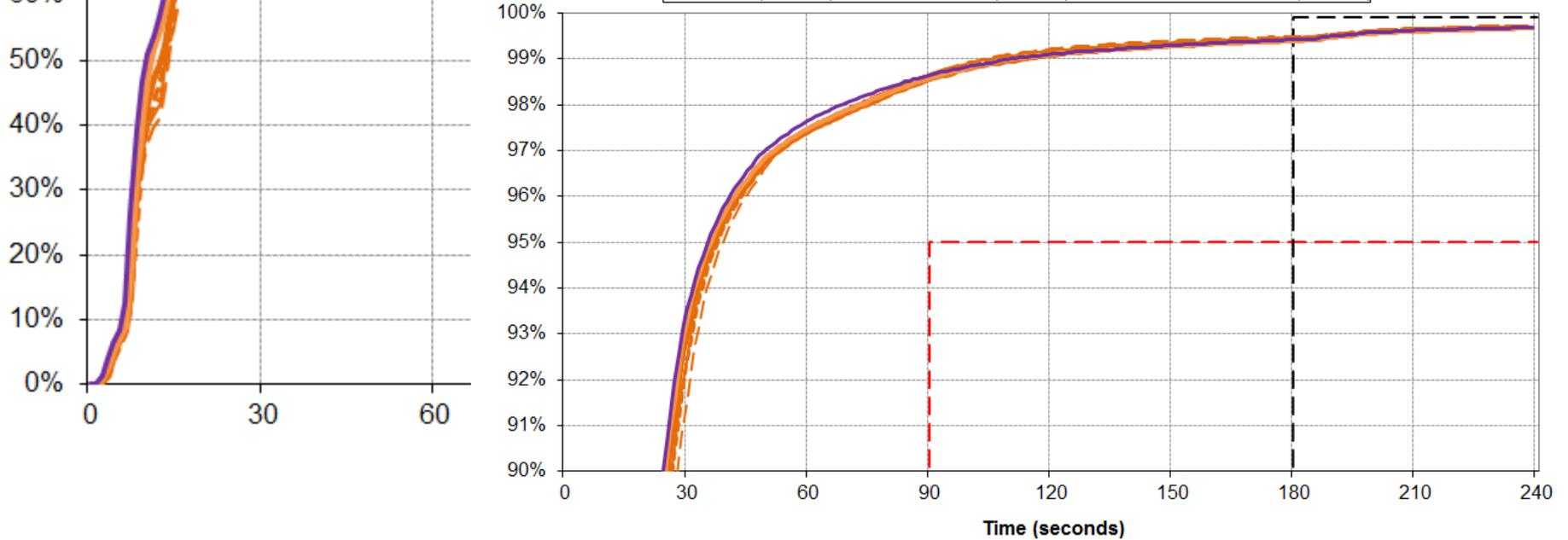
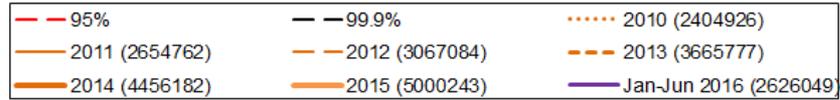
ANNUAL AGGREGATE FIR PERFORMANCE



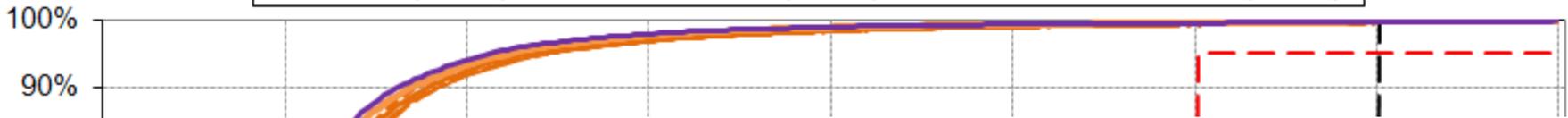
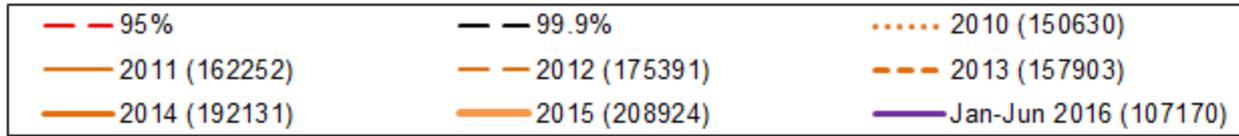
Actual Surveillance Performance (ASP) Oakland FIR Aggregate



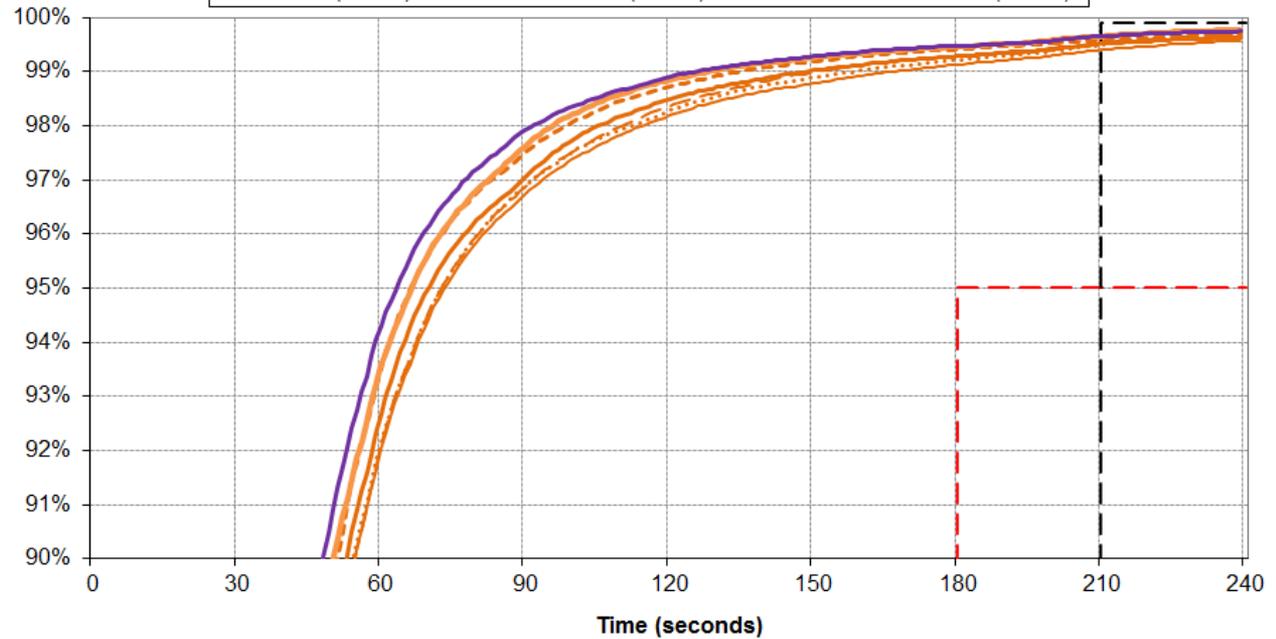
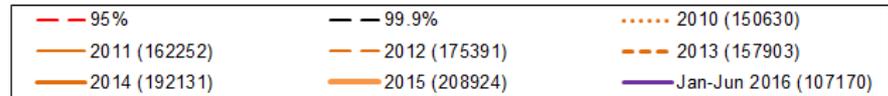
Actual Surveillance Performance (ASP) Oakland FIR Aggregate



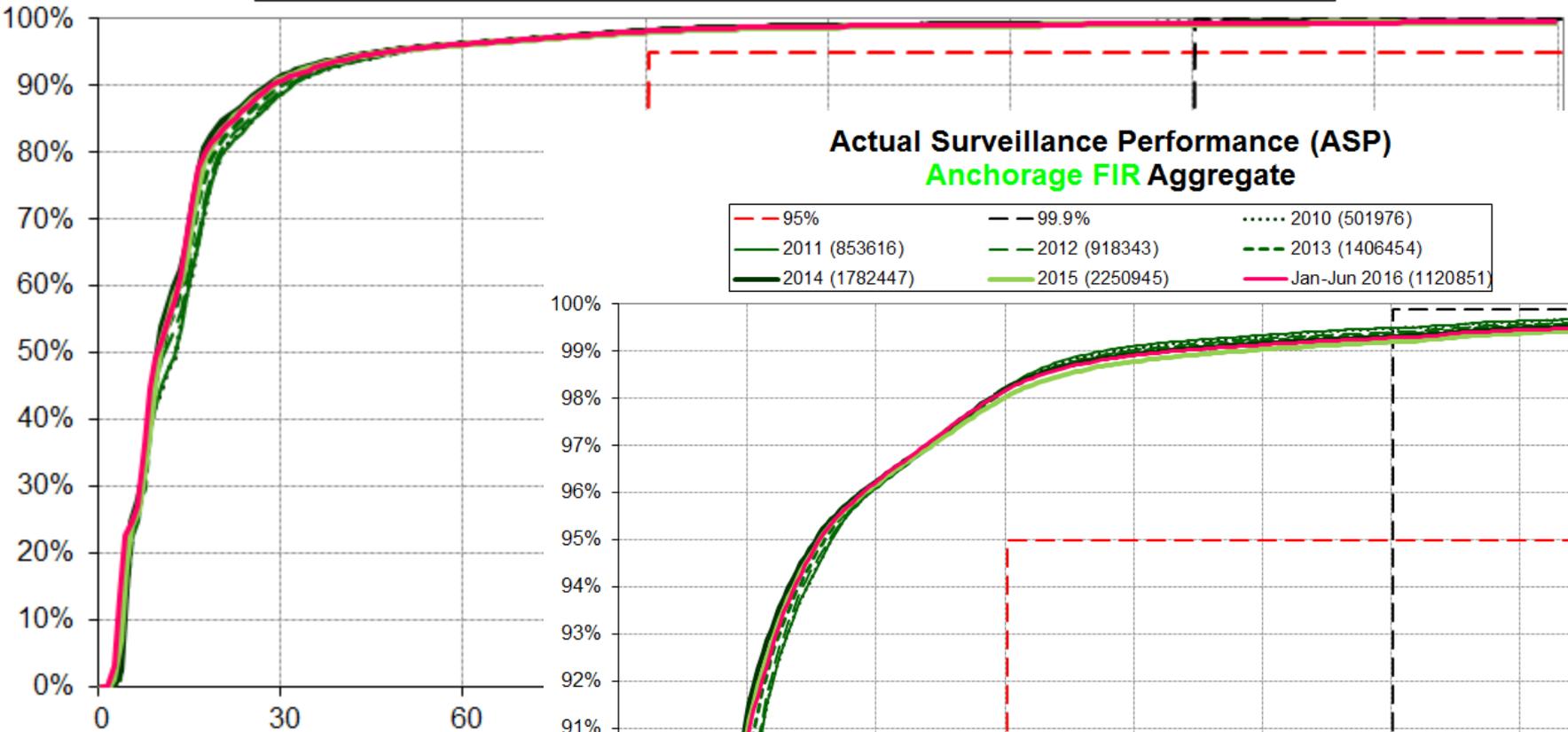
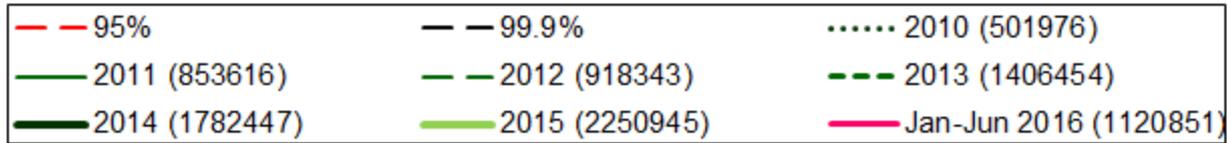
Actual Communication Performance (ACP) Oakland FIR Aggregate



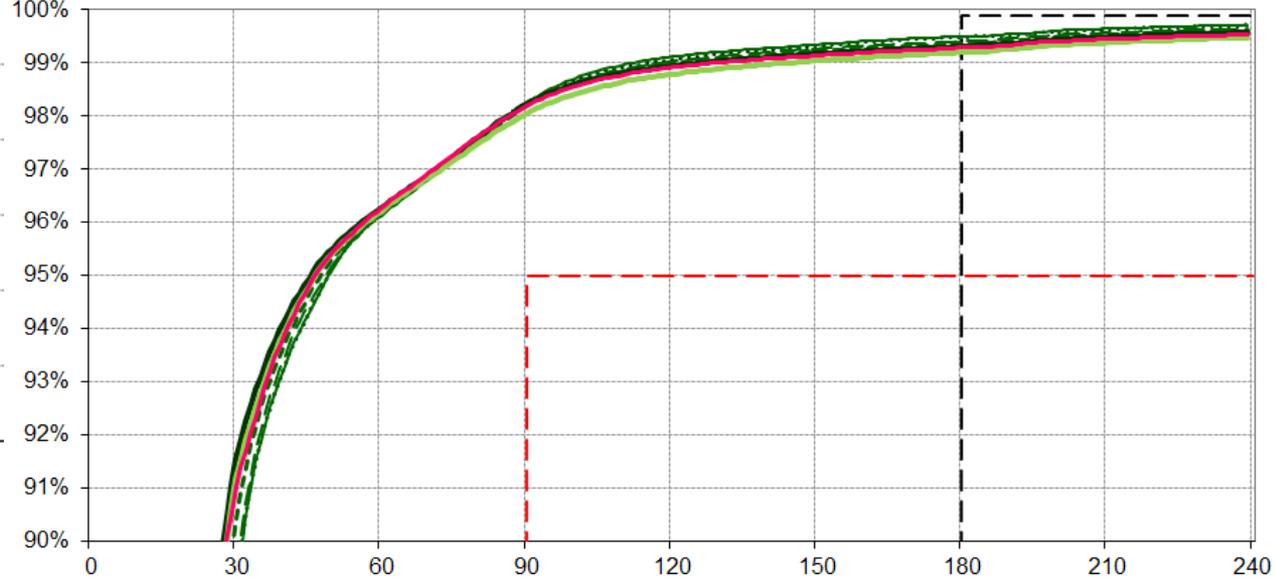
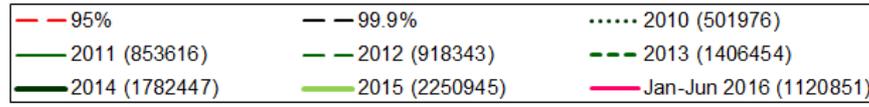
Actual Communication Performance (ACP) Oakland FIR Aggregate



Actual Surveillance Performance (ASP) Anchorage FIR Aggregate



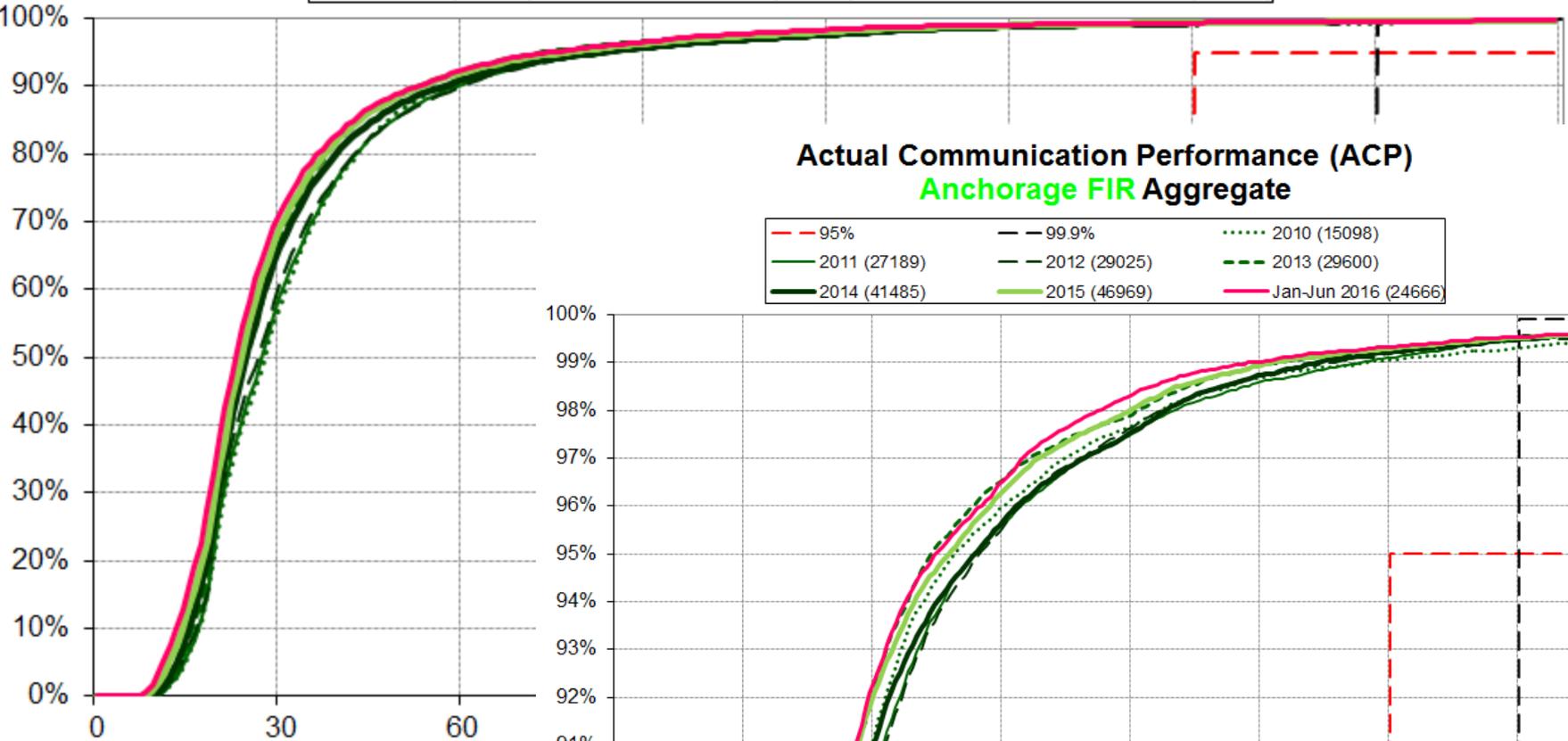
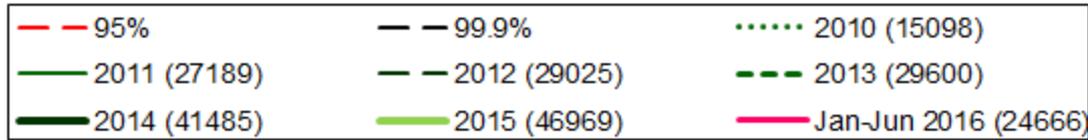
Actual Surveillance Performance (ASP) Anchorage FIR Aggregate



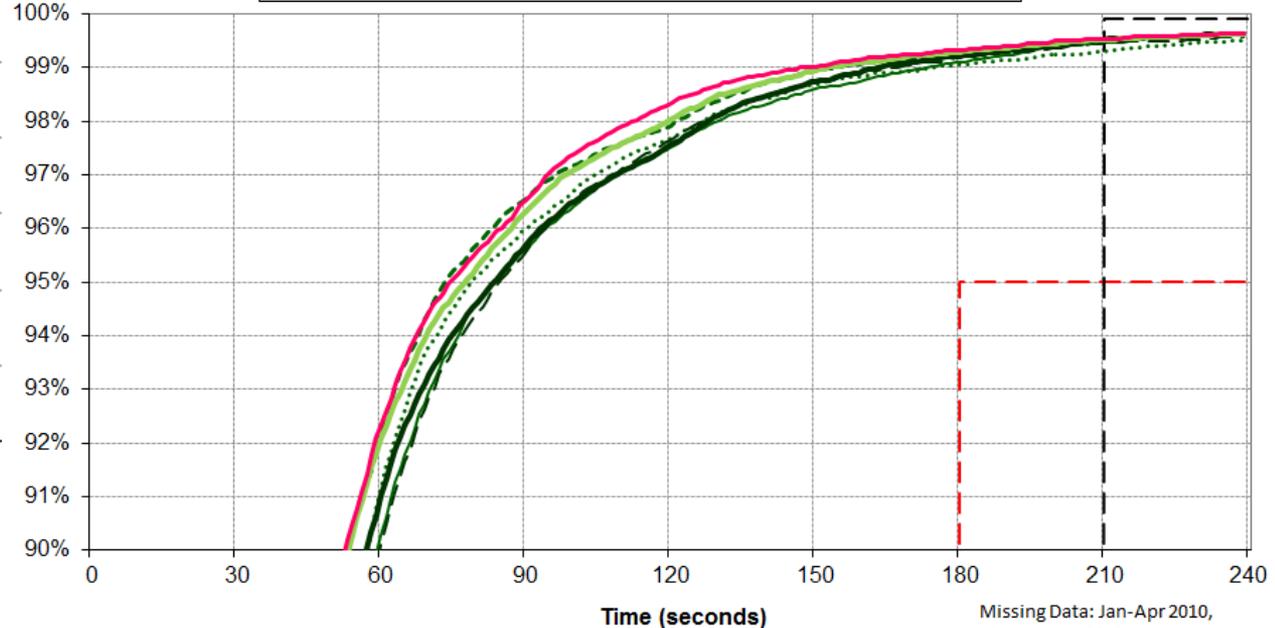
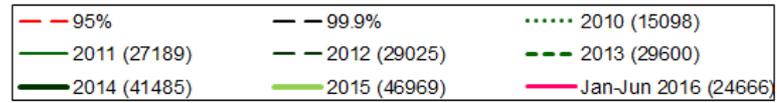
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Actual Communication Performance (ACP) Anchorage FIR Aggregate



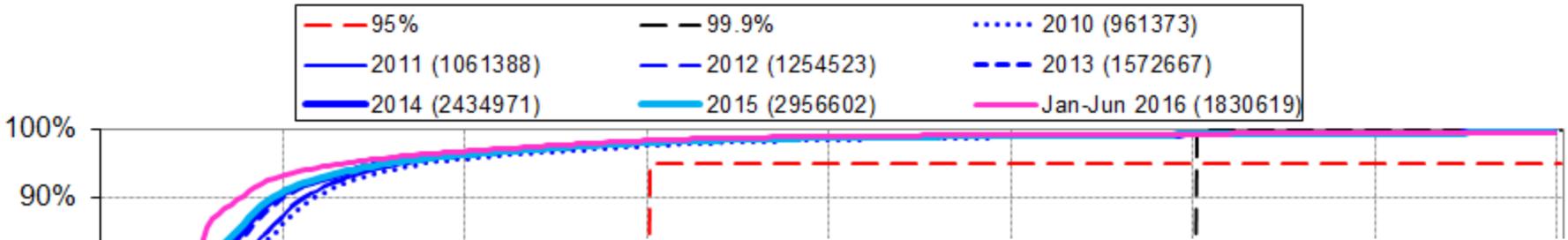
Actual Communication Performance (ACP) Anchorage FIR Aggregate



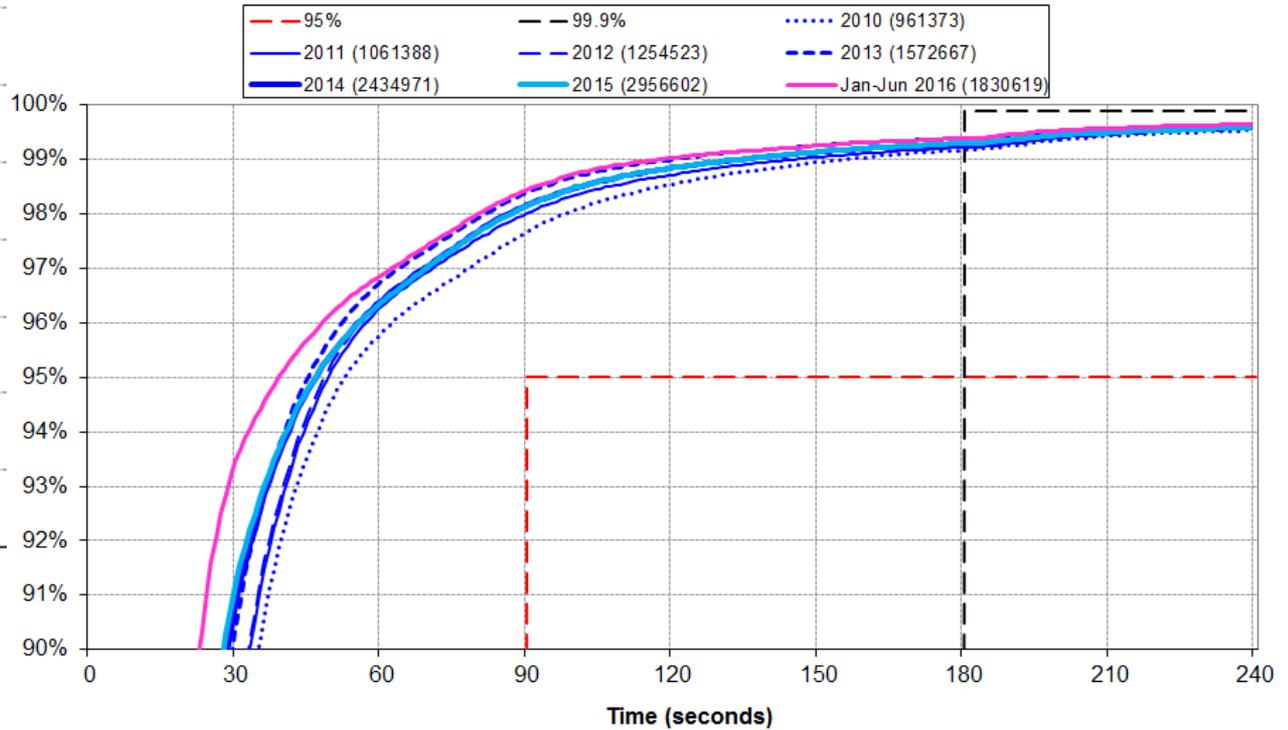
Missing Data: Jan-Apr 2010,
May and Jul 2012



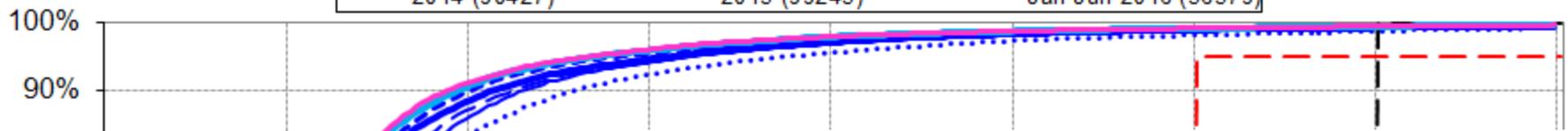
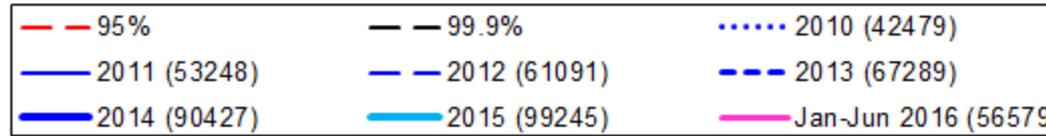
Actual Surveillance Performance (ASP) New York FIR Aggregate



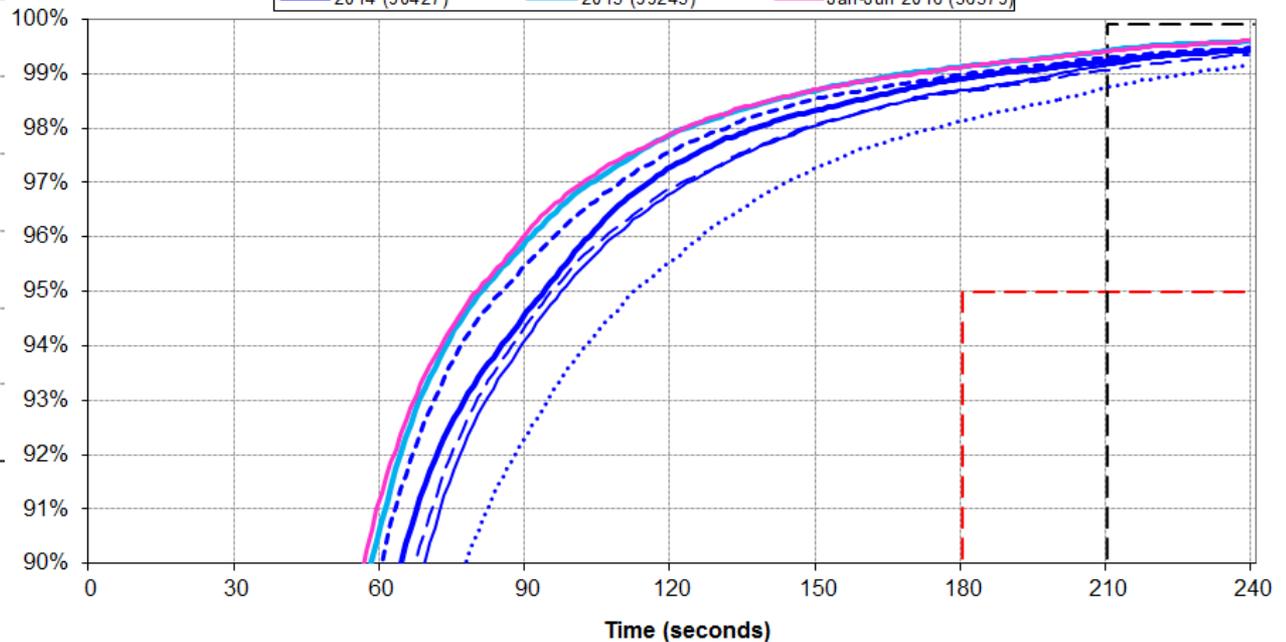
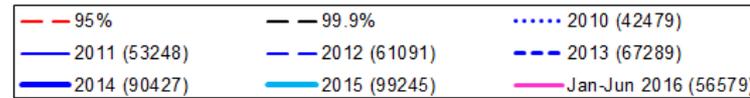
Actual Surveillance Performance (ASP) New York FIR Aggregate



Actual Communication Performance (ACP) New York FIR Aggregate



Actual Communication Performance (ACP) New York FIR Aggregate



- Station identifiers designate “path” taken by data link messages between aircraft and ATC
- “Paths” vary between the four constellations of satellites and between the two data link service providers

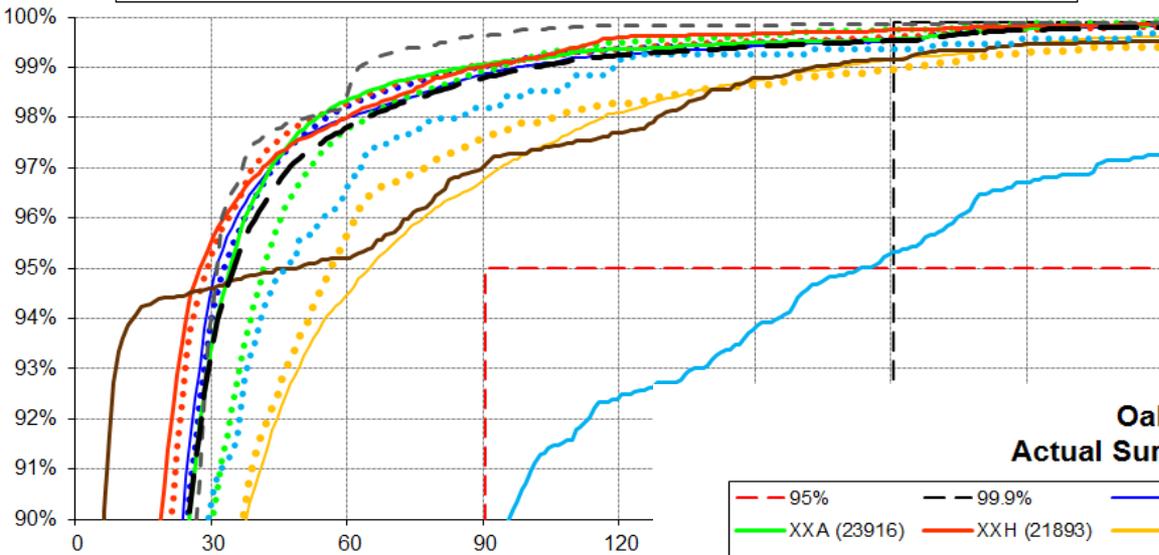
December 2015 and June 2016

ASP BY STATION IDENTIFIER

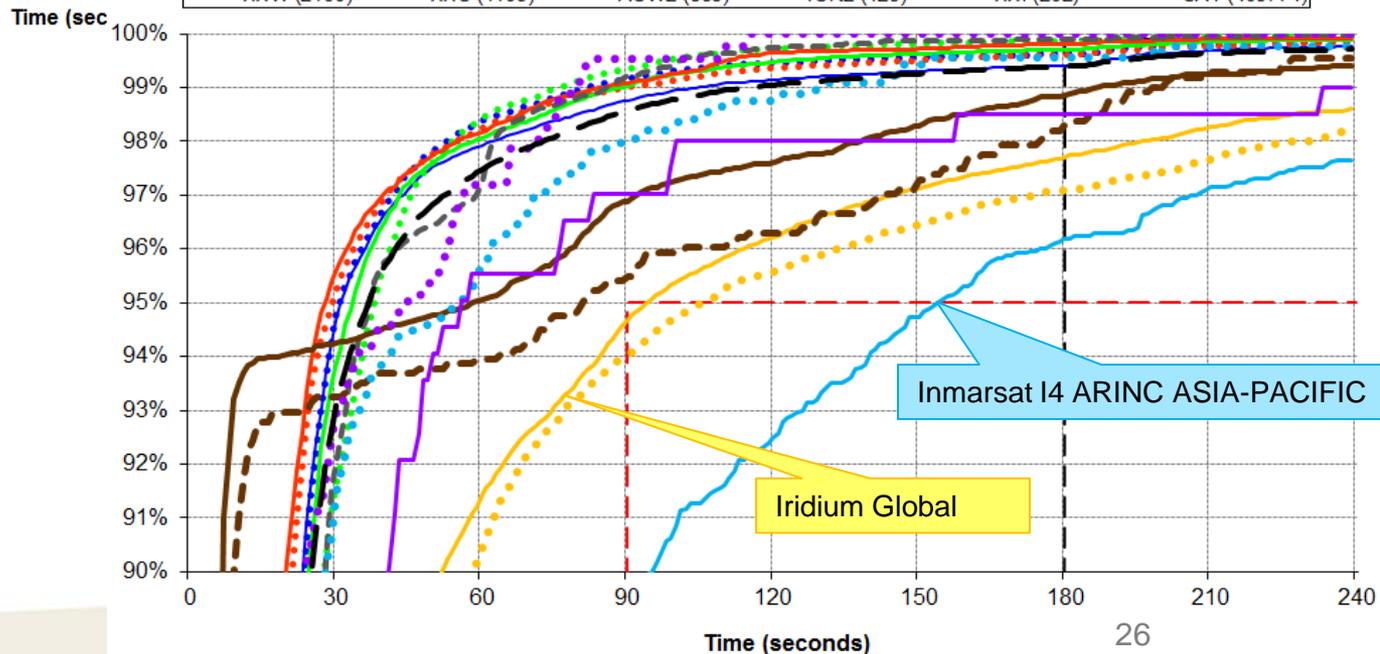
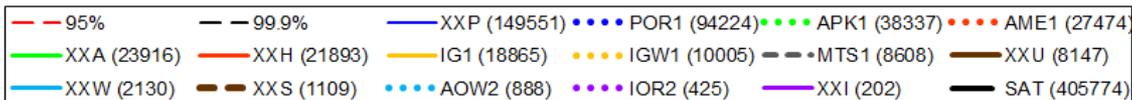


GES LOCATION(S)	SATELLITE/ REGION	SITA	ARINC
Borum, Netherlands	Inmarsat I-3 AOR-E	AOE2	XXN
	Inmarsat I-3 AOR-W	AOW2	XXW
Perth, Australia	Inmarsat I-3 IOR	IOR2	XXI
	Inmarsat I-3 POR	POR1	XXP
Fucino, Italy	Inmarsat I-4 EMEA	EUA1	XXF
	Inmarsat I-4 EMEA SBB	EME9	XXB
Paumalu, Hawaii, US	Inmarsat I-4 Americas	AME1	XXH
	Inmarsat I-4 Asia-Pacific	APK1	XXA
	Inmarsat I-4 Americas SBB	AMR9	XXU
	Inmarsat I-4 Asia-Pacific SBB	PAC9	XXS
Kobe and Hitachiota, Japan	MTSAT Japan	MTS1	--
Phoenix, Arizona, US	Iridium Global	IGW1	IG1

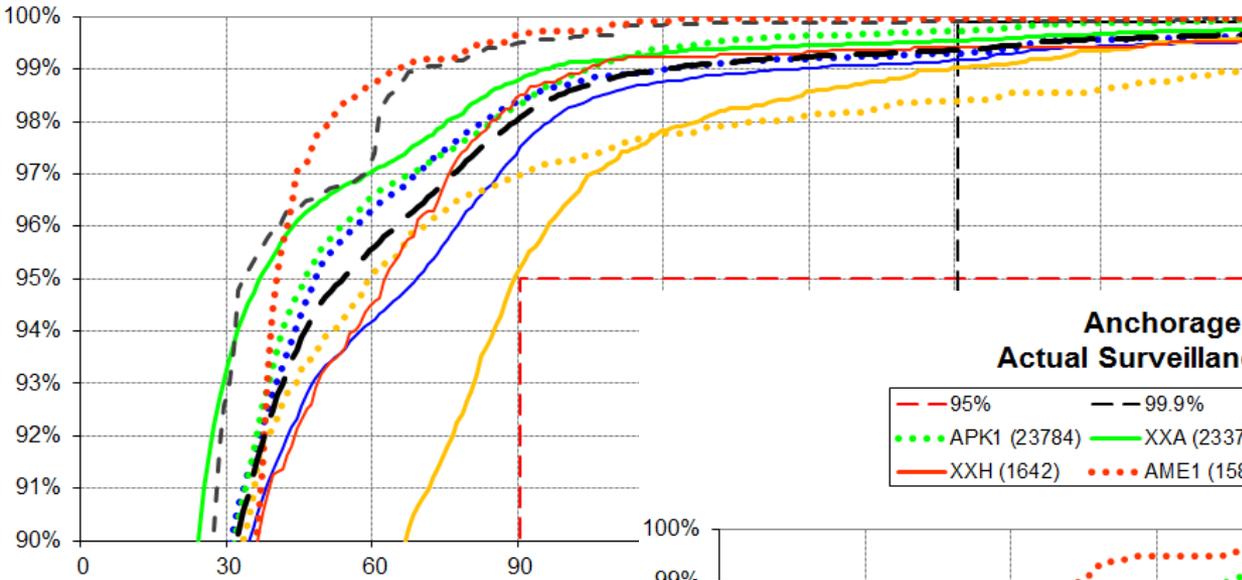
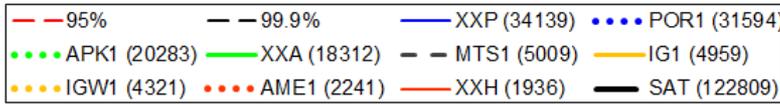
Oakland FIR - December 2015 Actual Surveillance Performance (ASP)



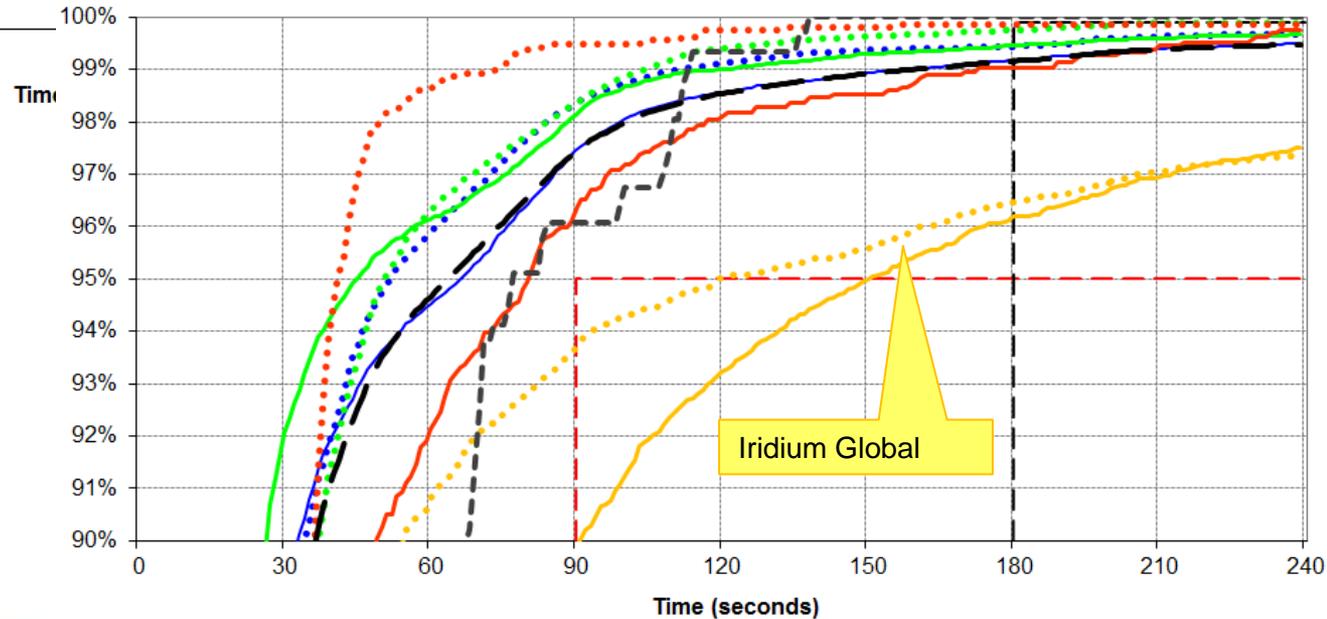
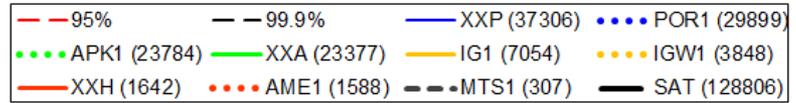
Oakland FIR - June 2016 Actual Surveillance Performance (ASP)



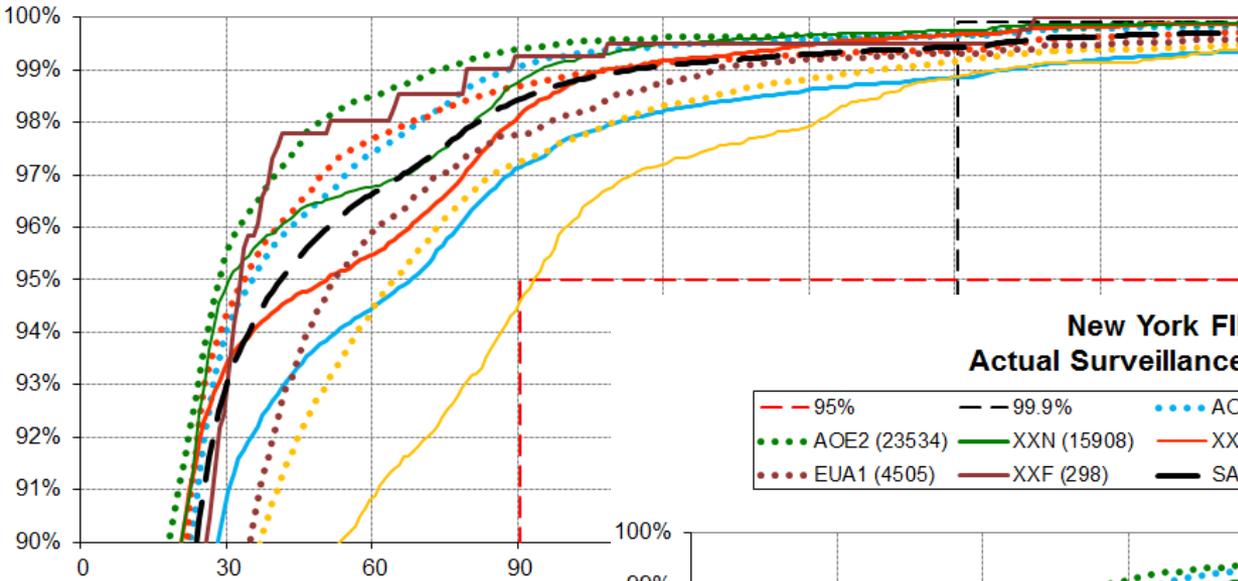
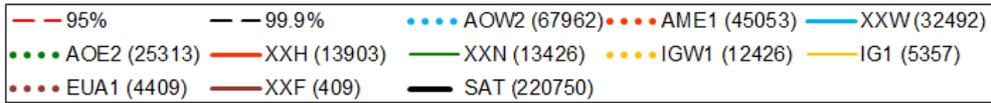
Anchorage FIR - December 2015 Actual Surveillance Performance (ASP)



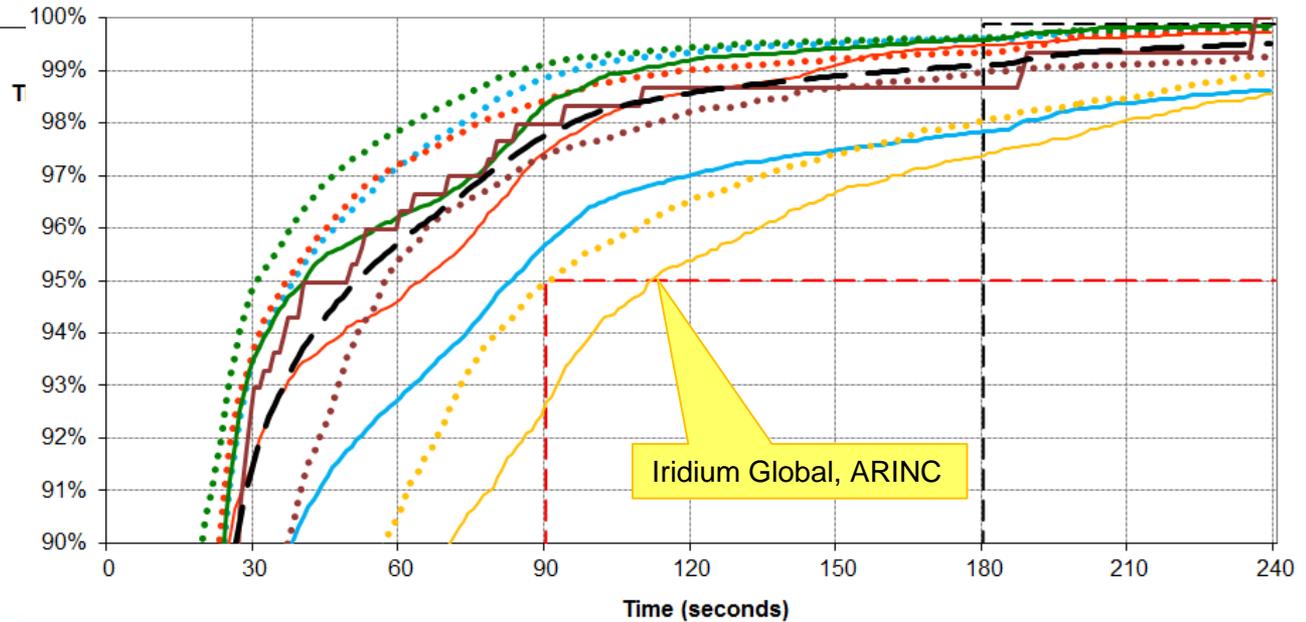
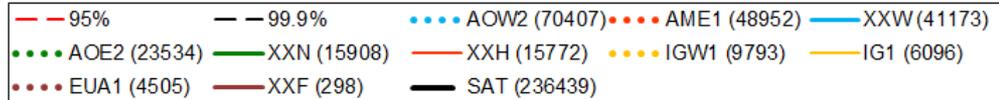
Anchorage FIR - June 2016 Actual Surveillance Performance (ASP)



New York FIR - December 2015 Actual Surveillance Performance (ASP)



New York FIR - June 2016 Actual Surveillance Performance (ASP)



January – June 2016

DATA LINK PERFORMANCE BY OPERATOR/AIRCRAFT TYPE



Summary of Performance by Operator/Aircraft Type

Oakland FIR

- **142** operator/aircraft type pairs with at least 100 ADS-C messages
- **93** operator/aircraft type pairs with at least 100 RCP transactions during this 6-month period

Criteria	RSP180 ASP	RCP240 ACTP	RCP240 ACP	RCP240 PORT
Meets 95%	140	93	93	88
Meets 99.9%	27	39	41	
Below 99.9% but above 99.0%	99	52	47	
Below 99.0%	16	2	5	
Total pairs	142	93		

Operator/Aircraft Types Not Meeting RSP180/RCP240

Oakland FIR

January – June 2016

Operator/ Aircraft Type	ADS-C				CPDLC						
	Count of ADS-C	% of Total ADS-C	ADS-C 95%	ADS-C 99.9%	Count of CPDLC	% of Total CPDLC	ACTP 95%	ACTP 99.9%	ACP 95%	ACP 99.9%	PORT 95%
A/B753	372	0.0%	87.6%	91.1%	0						
CG/BLCF	121	0.0%	94.2%	100.0%	0						

Summary of Performance by Operator/Aircraft Type

Anchorage FIR

- 93 operator/aircraft type pairs with at least 100 ADS-C messages
- 52 operator/aircraft type pairs with at least 100 RCP transactions during this 6-month period

Criteria	RSP180 ASP	RCP240 ACTP	RCP240 ACP	RCP240 PORT
Meets 95%	91	52	52	48
Meets 99.9%	20	26	21	
Below 99.9% but above 99.0%	61	21	24	
Below 99.0%	12	5	7	
Total pairs	93	52		

Operator/Aircraft Types Not Meeting RSP180/RCP240

Anchorage FIR

January – June 2016

Operator/ Aircraft Type	ADS-C				CPDLC						
	Count of ADS-C	% of Total ADS-C	ADS-C 95%	ADS-C 99.9%	Count of CPDLC	% of Total CPDLC	ACTP 95%	ACTP 99.9%	ACP 95%	ACP 99.9%	PORT 95%
CY/B788	921	0.1%	93.4%	94.6%	18	0.1%	77.8%	77.8%	77.8%	77.8%	100.0%
S/B763	151	0.0%	92.7%	96.0%	4	0.0%	100.0%	100.0%	100.0%	100.0%	100.0%

Summary of Performance by Operator/Aircraft Type

New York FIR

- **229** operator/aircraft type pairs with at least 100 ADS-C messages
- **90** operator/aircraft type pairs with at least 100 RCP transactions during this 6-month period

Criteria	RSP180 ASP	RCP240 ACTP	RCP240 ACP	RCP240 PORT
Meets 95%	222	90	90	77
Meets 99.9%	77	43	23	
Below 99.9% but above 99.0%	119	42	55	
Below 99.0%	33	5	12	
Total pairs	229	90		

Operator/Aircraft Types Not Meeting RSP180/RCP240

New York FIR

January - June 2016

Operator/ Aircraft Type	ADS-C				CPDLC						
	Count of ADS-C	% of Total ADS-C	ADS-C 95%	ADS-C 99.9%	Count of CPDLC	% of Total CPDLC	ACTP 95%	ACTP 99.9%	ACP 95%	ACP 99.9%	PORT 95%
A/B752	12,230	0.7%	94.1%	97.2%	233	0.4%	97.0%	97.9%	97.0%	98.7%	95.7%
L/B752	10,376	0.6%	94.3%	97.0%	175	0.3%	100.0%	100.0%	98.9%	98.9%	96.6%
Y/B763(N)	657	0.0%	92.9%	96.2%	0						
CV/B744	230	0.0%	93.9%	94.8%	0						
FA/B788	226	0.0%	85.0%	94.7%	0						
FF/A318	213	0.0%	93.4%	96.7%	0						
R/B738	129	0.0%	88.4%	89.9%	0						

FANS OVER IRIDIUM

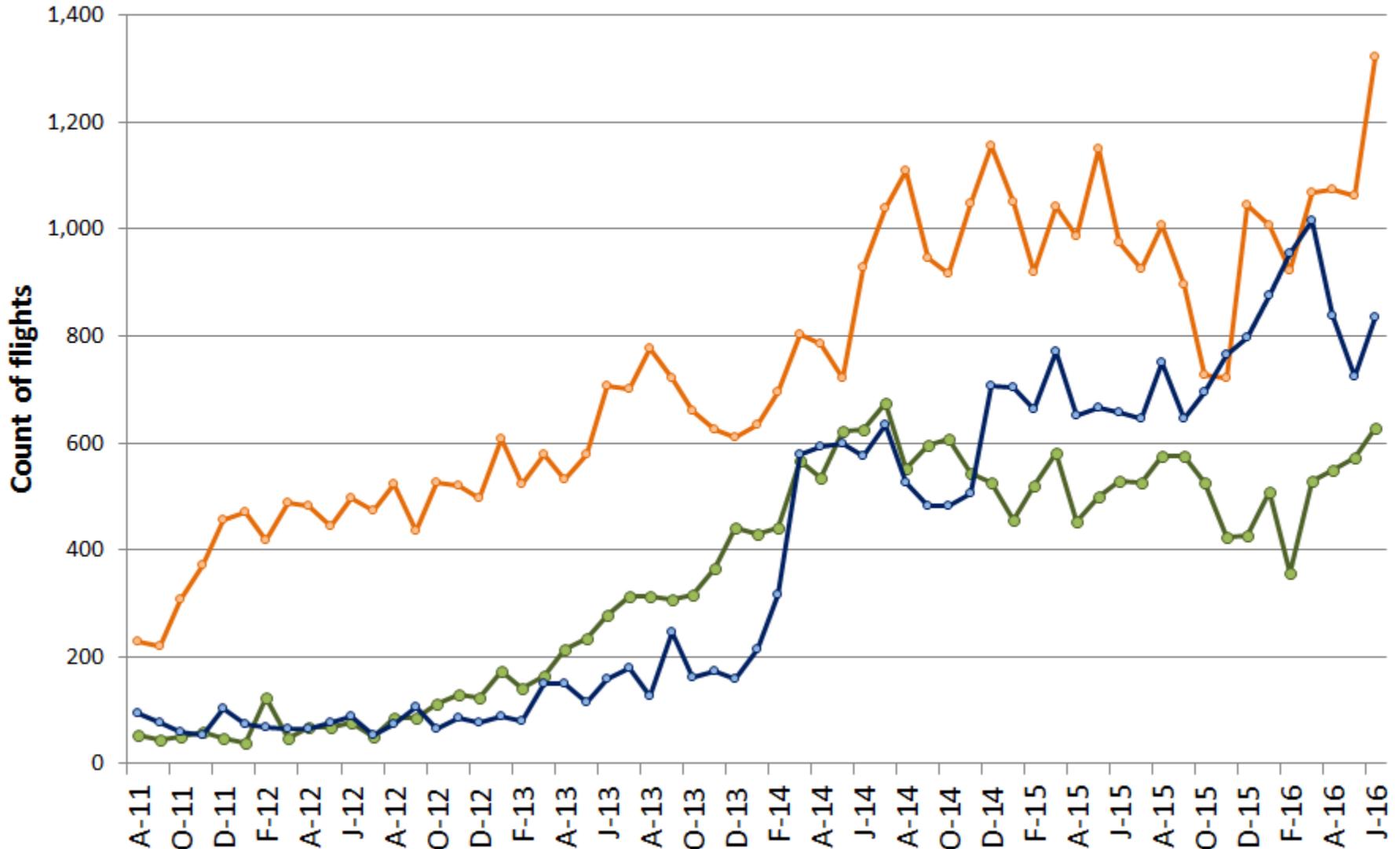


FANS over Iridium Data Link Usage

	KZNY		KZAK		PAZA	
	Jul-Dec 2015	Jan-Jun 2016	Jul-Dec 2015	Jan-Jun 2016	Jul-Dec 2015	Jan-Jun 2016
% FANS data link flights using Iridium	7%	8%	6%	7%	9%	9%
Average flights/day using Iridium	24	29	30	36	17	17
% FANS data link airframes using Iridium	9%	9%	10%	11%	10%	11%
Total airframes using Iridium	270	305	248	295	165	180

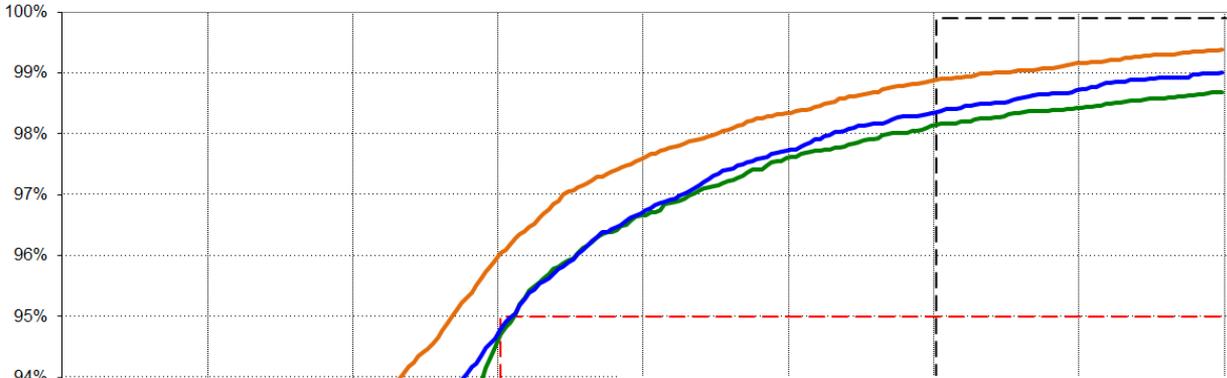
Iridium Usage

—●— PAZA —●— KZAK —●— KZNY



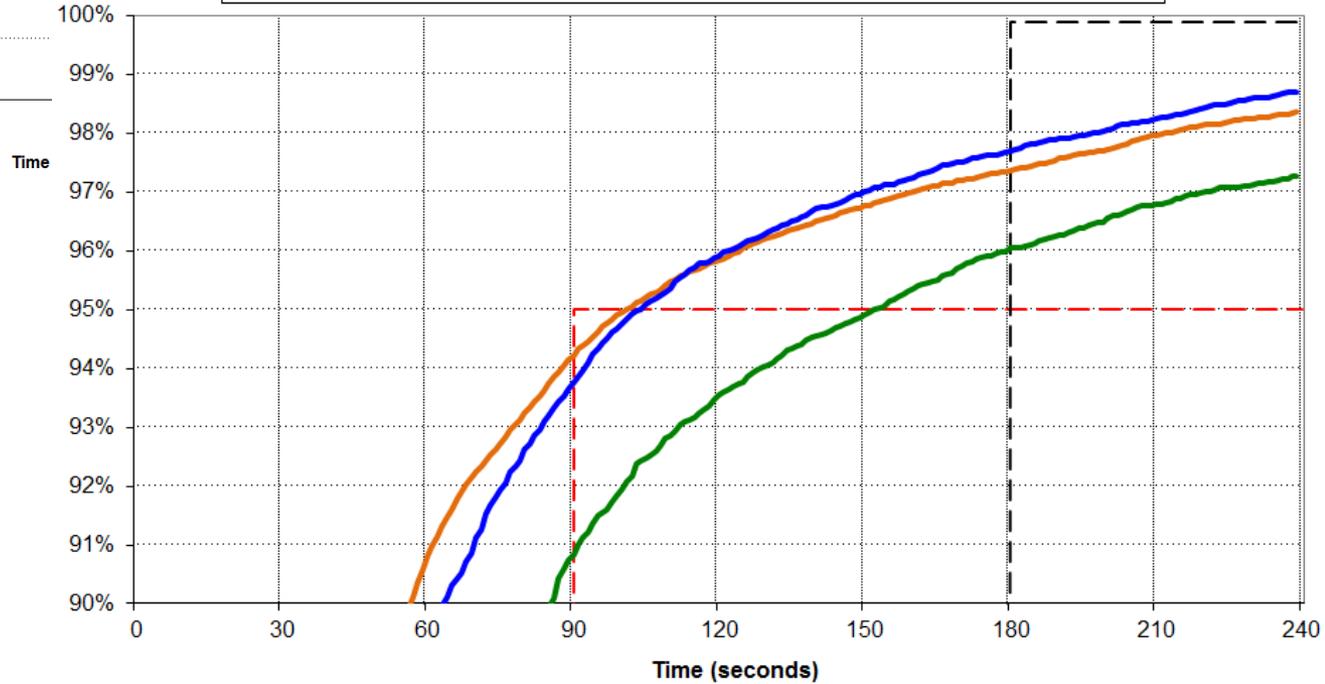
Actual Surveillance Performance (ASP) Iridium - June 2015

— 95% - - 99.9% — KZAK (22742) — PAZA (9731) — KZNY (11445)



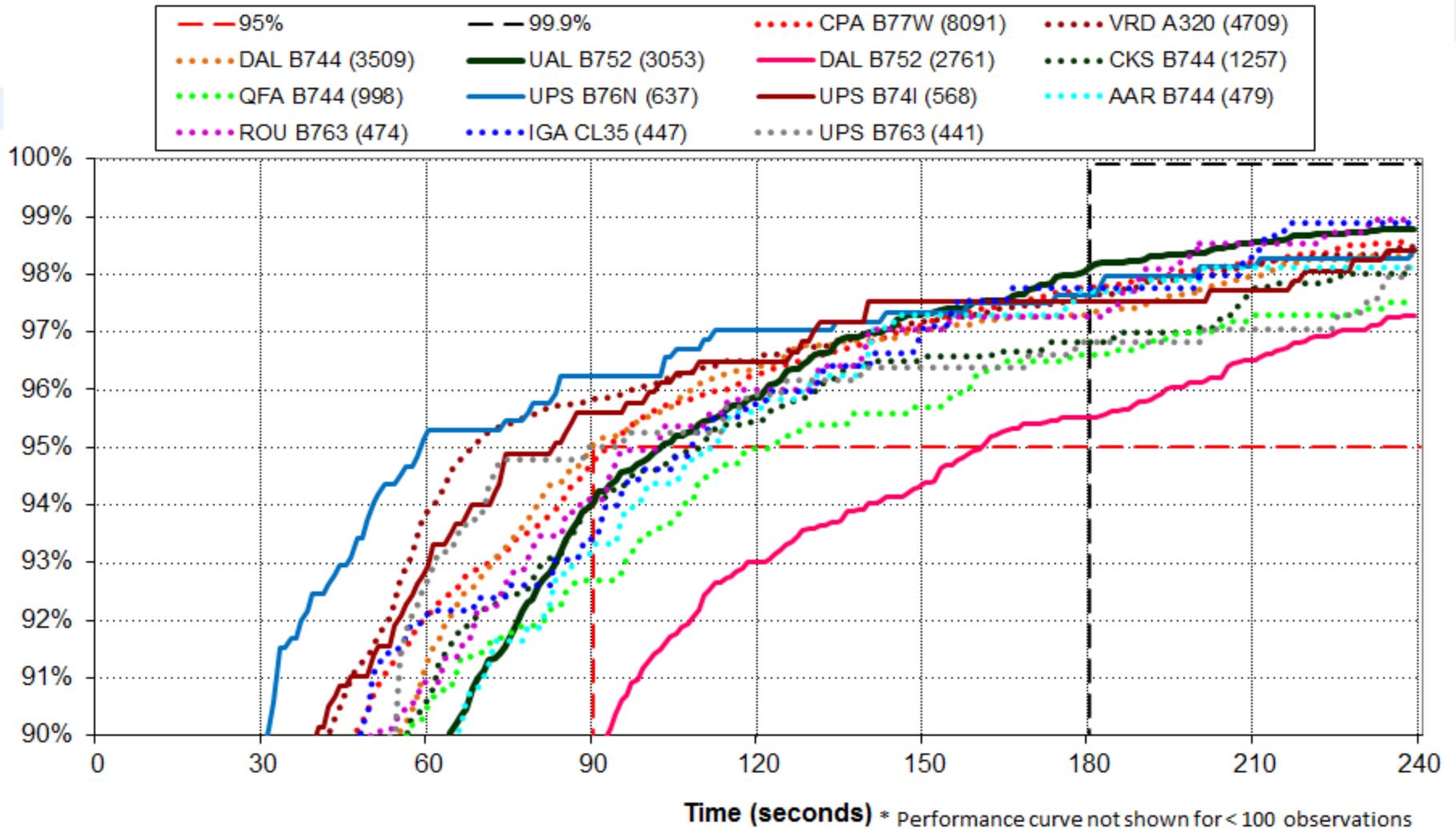
Actual Surveillance Performance (ASP) Iridium - June 2016

— 95% - - 99.9% — KZAK (28957) — PAZA (10984) — KZNY (15999)

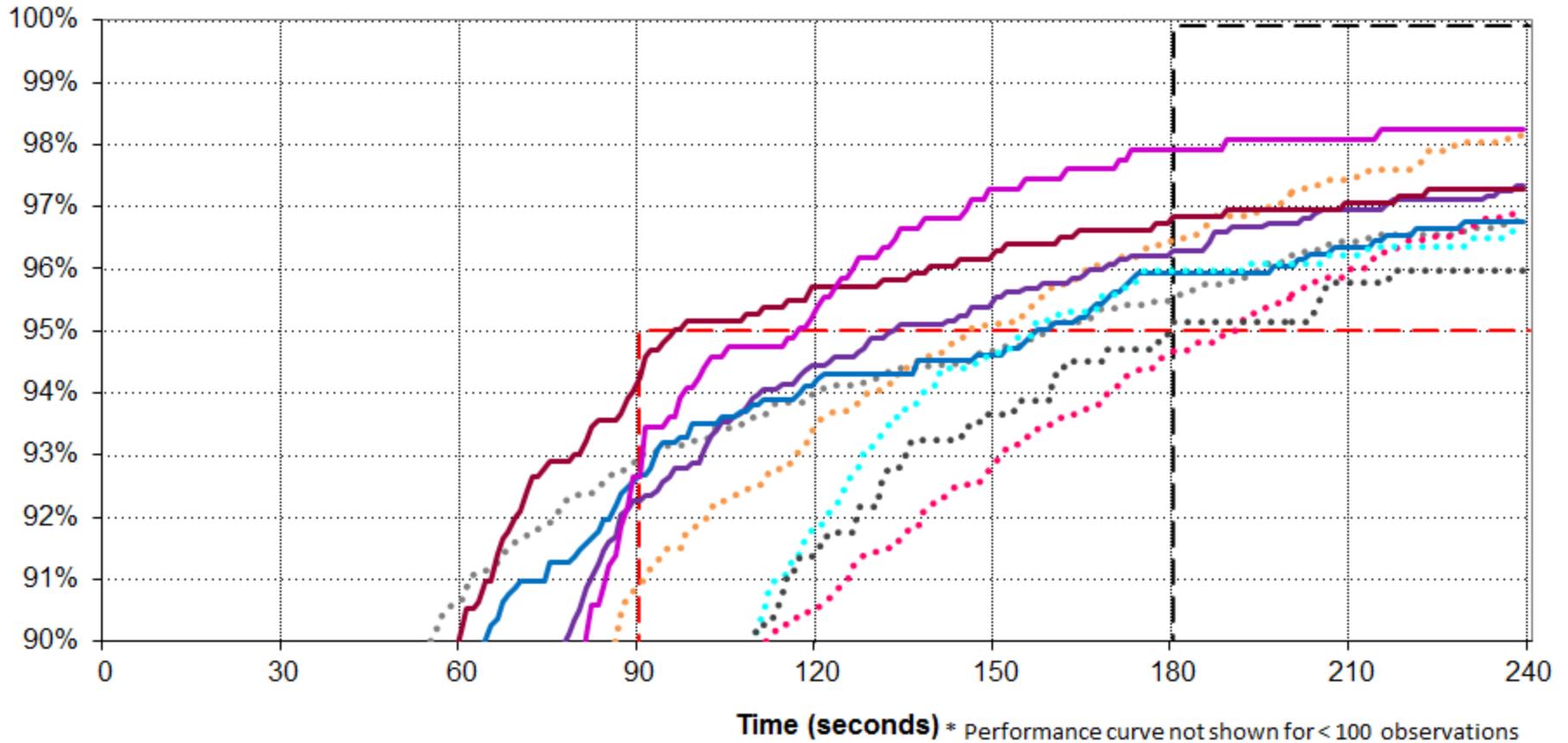
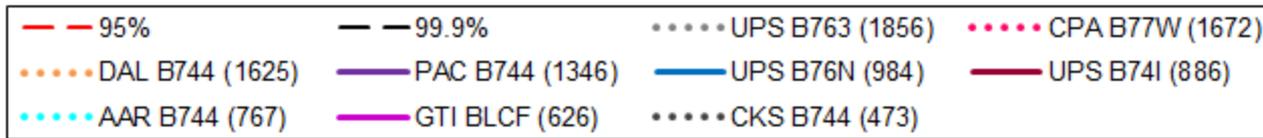


Oakland FIR - Iridium - June 2016

Actual Surveillance Performance (ASP)

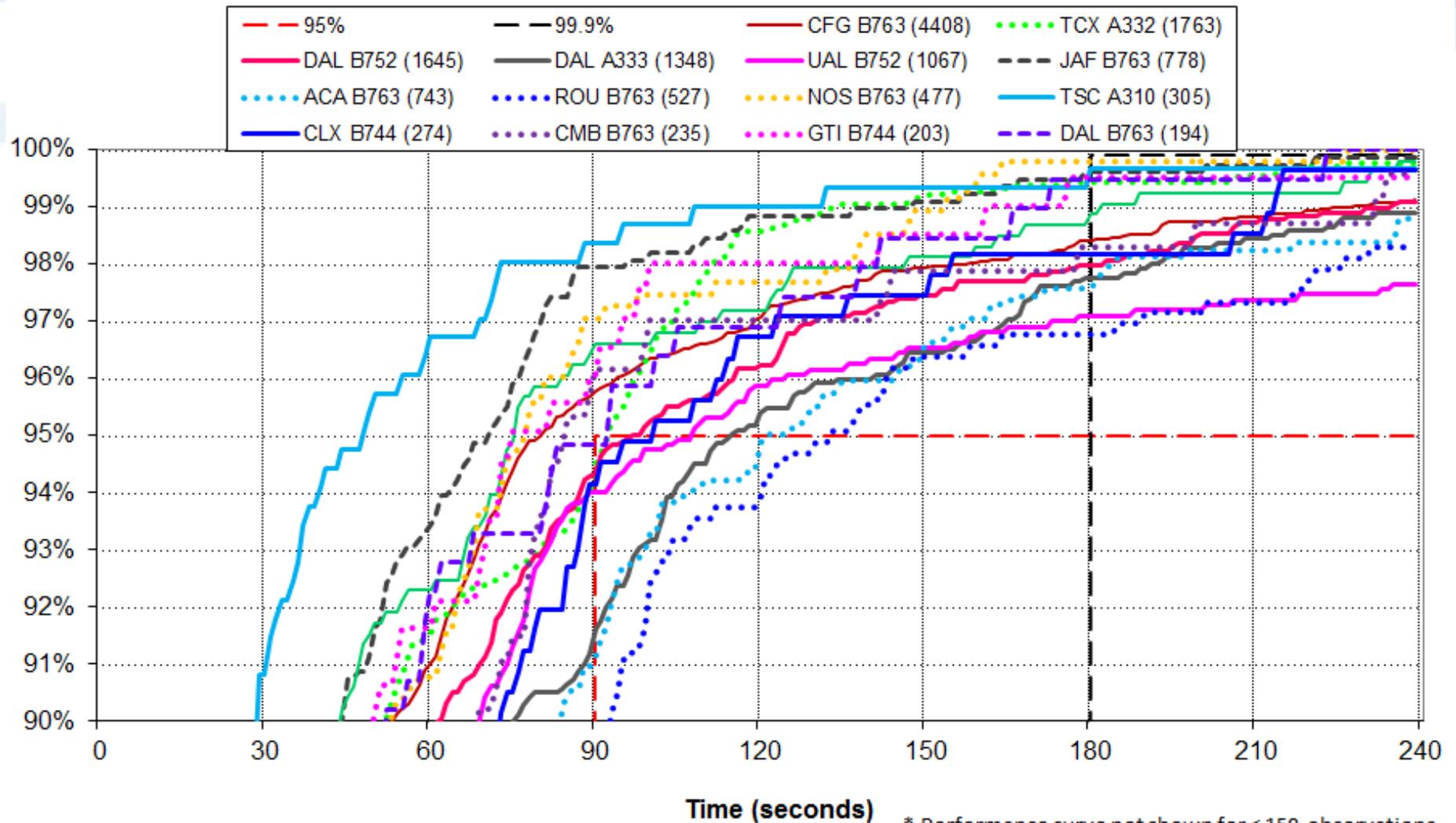


Anchorage FIR - Iridium - June 2016 Actual Surveillance Performance (ASP)



New York FIR - Iridium - August 2016

Actual Surveillance Performance (ASP)



CONCLUSIONS (1 of 4)

- Oakland FANS 1/A data link equipage:
 - ✦ The % flights using FANS 1/A data link in the aggregate Oakland oceanic FIR has held fairly constant near 65%
 - ✦ The % flights filing RNP4 surpassed the % flights using data link around July 2015 and has steadily increased (10% above the % of data link flights)
 - The % of RNP4 flights is 2% lower FANS 1/A flights.
- Anchorage FANS 1/A data link equipage:
 - ✦ The % flights filing RNP4 has increased to be approximately 6 percent less than the % flights using FANS 1/A data link.
- New York FANS 1/A data link equipage:
 - ✦ The % flights using FANS 1/A data link in the aggregate New York oceanic FIR has grown by 20% over the last 4 years
 - ✦ The % of RNP4 flights is 2% lower FANS 1/A flights.

CONCLUSIONS (2 of 4)

- The Oakland, New York and Anchorage oceanic FIRs:
 - ✦ The overall 95% criteria is met for RSP180 ASP and RCP240 ACTP, ACP and PORT for satellite, VHF and all media types combined
 - ✦ The performance at the levels specified by the 99.9% criteria is 99.0% or better for all performance measures for the aggregate, SAT and VHF
 - ✦ The 95 percent criterion for RSP400 ADS-C is not met for HF

CONCLUSIONS (3 of 4)

- During June 2016, the ASP was met for all “paths” in Oakland except:
 - ✦ XXW (ARINC, AOR-W, Burum GS)
 - ✦ IG1 and IGW1 (Iridium)
- During June 2016, the ASP was met for all “paths” in Anchorage except:
 - ✦ IG1 and IGW1 (Iridium)
- During June 2016, the ASP was met for all “paths” in New York except:
 - ✦ IG1 and IGW1 (Iridium)

CONCLUSIONS (4 of 4)

- The 95% criteria for RSP180 and RCP240 is being met for the majority of operator/aircraft types pairs.
- The usage of FANS 1/A over Iridium continues to increase
- The performance over Iridium is not consistently meeting the 95% requirements for RSP180 and RCP240
- The performance corresponding to “IG1” – Iridium over ARINC is observed to be notably lower than the other SAT paths
 - ✦ Notable performance degradation since May 2016 (PR submitted to DLMA)
 - ✦ Still observed to be variation between operators but overall downward shift